MANITOBA CANADA CONSERVATION AND RENEWABLE ENERGY DEMONSTRATION AGREEMENT

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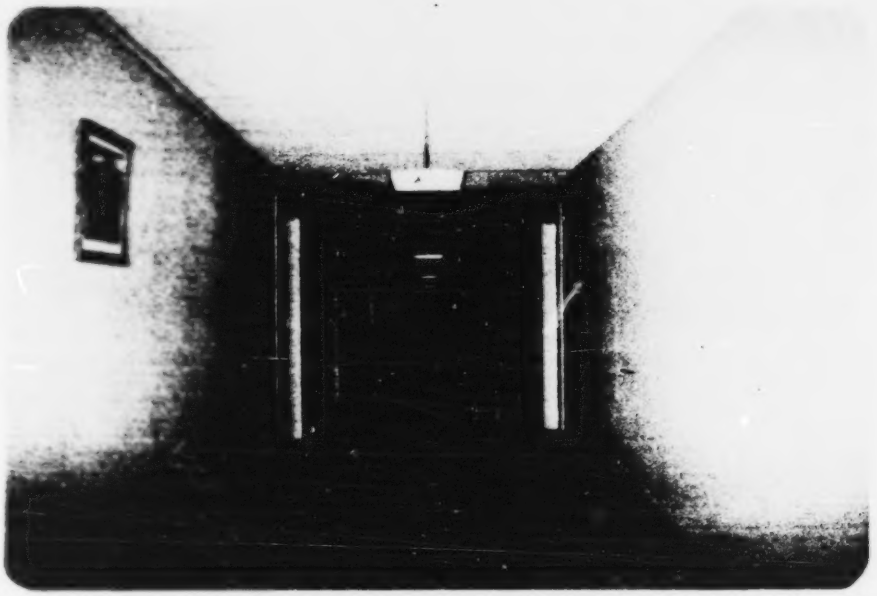

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ENERHOSP FINAL REPORT

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MANITOBA/CANADA CONSERVATION AND RENEWABLE ENERGY DEMONSTRATION AGREEMENT

The availability of secure and affordable energy supplies is a subject of national concern. It is an accepted fact that our primary energy sources — oil and natural gas — are becoming less accessible and more costly. However, Canada is well-endowed with renewable and alternative resources that can provide a bridge into the future.

To this end, the governments of Manitoba and Canada entered into a Conservation and Renewable Energy Demonstration Agreement which was signed May 9, 1980 and terminated March 31, 1984. The Agreement was dedicated to the development and demonstration of conservation and renewable energy technologies. Equally cost-shared by the provincial and federal governments, the program had a total budget of $18-million.

The objectives of CREDA are:

- To develop and demonstrate promising new technologies, which, when widely adopted, will exploit renewable resources, conserve energy and/or use energy more efficiently.
- To develop broad public awareness of the potential of renewable energy and conservation technology.
- To provide opportunities for the commercial application of the technologies within Manitoba.
- To create economic spin-off benefits for manufacturing, industry and commerce.
- To create employment in new or existing energy-related industries.

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In 1984, the governments of Manitoba and Canada initiated the Enerhosp programme. Technical and financial assistance was provided for testing and demonstrating various energy conservation measures in a total of eight Manitoba health care facilities. The total project funding was 1.2 million dollars and was allocated as follows. Two personal care home facilities received $50,000 each. Each of two small, medium and large hospitals received $39,000, $120,000, and $275,000 respectively. The Enerhosp programme comprised two broad tasks: Task I: Assessing the Facilities and Task II: Implementing the Energy Conservation Techniques.

Task I: Assessing the Facilities was accomplished through a facility index survey. Manitoba health care facilities were categorised and assessed according to their energy usage characteristics. Energy cost, energy consumption, and unit energy price indices were determined for each facility in each category. This procedure provided a means of selecting eight health care facilities which were good candidates for energy conservation but which were also well distributed across the province.

Task II: Implementing the Energy Conservation Techniques brought energy conservation measures through to their implementation. Each retrofit is summarised below.

Personal Care Homes

St. Paul's Residence, The Pas

actual implementation cost	$ 22 000
expected energy saving	500 000 kW.h/yr
expected cost saving	$ 19 000/yr
simple payback	1.2 years

Foyer Notre Dame, Notre Dame de Lourdes

actual implementation cost	$ 49 700
expected energy saving	400 000 kW.h/yr
expected cost saving	$ 12 000/yr
simple payback	4.1 years

Small Hospitals

Johnson Memorial Hospital, Gimli

actual implementation cost	$ 25 500
expected energy saving	300 000 kW.h/yr
expected cost saving	$ 5 400/yr
simple payback	4.7 years

Swan River Valley Hospital, Swan River

actual implementation cost	$ 35 900
expected energy saving	850 000 kW.h/yr
expected cost saving	$ 28 000/yr
simple payback	1.3 years

Medium Hospitals

Concordia Hospital, Winnipeg

actual implementation cost	$121 000
expected energy saving	1 200 000 kW.h/yr
expected cost saving	$ 20 000/yr
simple payback	6.1 years

Thompson General Hospital, Thompson

actual implementation cost	$113 000
expected energy saving	700 000 kW.h/yr
expected cost saving	$ 22 000/yr
simple payback	5.1 years

Large Hospitals

Brandon General Hospital, Brandon

actual implementation cost	$283 000
expected energy saving	5 500 000 kW.h/yr
expected cost saving	$71 000/yr
simple payback	4.0 years

Salvation Army Grace General Hospital, Winnipeg

actual implementation cost	$265 000
expected energy saving	7 000 000 kW.h/yr
expected cost saving	$ 60 000/yr
simple payback	4.4 years

Totals

total implementation cost	$915 100
total expected energy saving	16 500 000 kW.h/yr
total expected cost saving	$237 000/yr
overall simple payback	3.9 years

The installations will be complete in 1985 at which time monitoring and evaluation will begin. All areas of energy conservation studied during this programme should be considered by other health care facilities. The only notable exception is the upgrading of wall and roof insulation which, in general, showed long, uneconomical payback periods. The total programme was highly successful with an overall payback of 3.9 years. This suggests that other health care facilities should explore their potential for energy conservation. Substantial savings can be achieved.

SOMMAIRE

En 1984, les gouvernements du Manitoba et du Canada ont lancé le programme Énerhosp dans le cadre duquel on offrait une aide financière et technique pour la mise à l'essai et la mise en oeuvre de diverses mesures d'économie d'énergie dans huit établissements manitobains de soins de santé. Les subventions ainsi consenties s'élevaient à 1,2 million dollars répartis comme suit: 50 000 $ chacun à deux établissements de soins; 39 000 $, 120 000 $ et 275 000 $ chacun à deux petits hôpitaux, deux hôpitaux de taille moyenne et deux grands hôpitaux, respectivement. Le programme Énerhosp comportait deux grands objectifs: Objectif I, Évaluation des établissements; Objectif II, Mise en oeuvre des techniques d'économie d'énergie.

Objectif I: L'évaluation des établissements s'est effectuée par sondage sur index. Ainsi, les établissements de soins de santé du Manitoba ont été classifiés et évalués en fonction de leurs caractéristiques de consommation d'énergie. Les coûts en énergie, la consommation et les index de prix unitaires ont donc été calculés pour chaque établissement de chaque catégorie. Cette façon de procéder a permis de choisir huit établissements de soins de santé qui convenaient bien aux mesures d'économie d'énergie envisagées et qui étaient répartis dans toute la province.

Objectif II: Mise en oeuvre des techniques d'économie d'énergie. Les mesures d'amélioration adoptées sont résumées ci-après.

Établissements de soins personnels

St. Paul's Residence, Le Pas

Coût réel de mise en oeuvre	22 000 $
Économie d'énergie prévue	500 000 kWh/an
Économies prévues	19 000 $/an
Délai de récupération au taux simple	1,2 an

Foyer Notre Dame, Notre Dame de Lourdes

Coût réel de mise en oeuvre	49 700 $
Économie d'énergie prévue	400 000 kWh/an
Économies prévues	12 000 $/an
Délai de récupération au taux simple	4,1 ans

Petits hôpitaux

Johnson Memorial Hospital, Gimli

Coût réel de mise en oeuvre	25 000 $
Économie d'énergie prévue	300 000 kWh/an
Économies prévues	5 400 $/an
Délai de récupération au taux simple	4,7 ans

Swan River Valley Hospital, Swan River

Coût réel de mise en oeuvre	35 900 $
Économie d'énergie prévue	850 000 kWh/an
Économies prévues	28 000 $/an
Délai de récupération au taux simple	1,3 an

Hôpitaux de taille moyenne

Concordia Hospital, Winnipeg

Coût réel de mise en oeuvre	121 000 $
Économie d'énergie prévue	1 200 000 kWh/an
Économies prévues	20 000 $/an
Délai de récupération au taux simple	6,1 ans

Thompson General Hospital, Thompson

Coût réel de mise en oeuvre	113 000 $
Économie d'énergie prévue	700 000 kWh/an
Économies prévues	22 000 $/an
Délai de récupération au taux simple	5,1 ans

Grands hôpitaux

Brandon General Hospital, Brandon

Coût réel de mise en oeuvre	283 000 $
Économie d'énergie prévue	5 500 000 kWh/an
Économies prévues	71 000 $/an
Délai de récupération au taux simple	4 ans

Salvation Army Grace General Hospital, Winnipeg

Coût réel de mise en oeuvre	265 000 $
Économie d'énergie prévue	7 000 000 kWh/an
Économies prévues	60 000 $/an
Délai de récupération au taux simple	4,4 ans

Totaux

Coût total de mise en oeuvre	915 100 $
Économie totale d'énergie prévue	16 500 000 kWh/an
Économies totales prévues	237 000 $/an
Délai global de récupération au taux simple	3,9 ans

Les travaux seront terminés en 1985, date à laquelle doivent commencer la surveillance et l'évaluation. Les autres établissements de soins de santé devraient envisager d'adopter les mêmes mesures d'économie d'énergie que celles étudiées dans le cadre du présent programme, la seule exception notable étant l'amélioration de l'isolant dans les murs et les toits dont les délais de récupération sont en général longs et peu justifiables sur le plan économique. Le programme a eu un grand succès, affichant un délai global de récupération de 3,9 ans. Ceci nous laisse croire que d'autres établissements de soins de santé devraient envisager d'instaurer les mesures recommandées, car il y a moyen de réaliser d'importantes économies d'énergie.

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In 1984, the governments of Manitoba and Canada initiated the Enerhosp programme under the Conservation and Renewable Energy Demonstration Agreement (CREDA). Technical and financial assistance was provided for testing and demonstrating various energy conservation measures in a number of Manitoba health care facilities. The project was administered by Manitoba Energy and Mines, Energy, Mines and Resources Canada, and the Manitoba Health Services Commission (MHSC).

Total project funding was 1.2 million dollars and was allocated as follows. Two personal care homes were allocated $50,000 each. Each of two small, medium, and large hospitals were allocated $39,000, $120,000 and $275,000 respectively. CREDA provided two-thirds of all project costs, the remaining third being provided by the involved health care facilities. The total project value included consultant costs.

The Enerhosp programme comprised two broad stages: Task I: Assessing the Facilities and Task II: Implementing the Energy Conservation Techniques. Task I was accomplished through the Facility Index Survey*. The MHSC established categories for health care facility comparison based on the number of beds at a facility. All eligible** Manitoba health care facilities were considered in the survey. Energy cost, energy consumption, and unit energy price indices were determined for each facility in each category. This procedure provided a means of determining which health care facilities were the best candidates for energy conservation. Once the eight facilities were selected, Task II was initiated. Task II brought energy conservation measures through to their

* The Facility Index Survey report will soon be available. For information contact Manitoba Energy and Mines or E.J. Faraci & Associates Ltd.

** See Section 1.2

implementation. The installation phases of the projects will be completed in 1985 at which time monitoring and evaluation will begin.

TASK I: ASSESSING THE FACILITIES

1.0 THE FACILITY INDEX SURVEY

1.1 Purpose

Task I of the Enerhosp programme consisted of a facility index survey. The survey was developed as a means of classifying Manitoba health care facilities according to annual energy consumption and annual energy cost. Eight facilities of varying size and function were to be identified as candidates for detailed energy conservation studies. These eight facilities were chosen from the results of the survey.

1.2 Method

An energy cost and consumption survey was performed on 160 Manitoba health care facilities. The facilities examined do not encompass all of the health care facilities in the province. Some were automatically omitted because they are privately owned and operated, too new to have a full year of operation time, or scheduled to be completely renovated or destroyed. A questionnaire requesting energy cost and consumption data for the 1983-1984 fiscal year was sent to the administration department of each facility. The consultant used these questionnaires and the most updated drawings available at the MHSC to calculate energy cost, energy consumption, and unit energy price indices.

The indices for the Enerhosp programme are based on the facilities' gross floor areas. These were taken from the most recent drawings available at the MHSC. Measurements of the facilities were done in accordance with the Canadian Standard Association publication, Area Measurement for Health Care Facilities. The standard specifies the gross floor area as the area contained within the perimeter line of the exterior facing material.

Crawlspaces, unheated garages, and unheated storage annexes were not included.

To compare the indices, four categories were defined, as follows. Hospitals were categorized according to the number of available beds. Small hospitals have less than 100 beds, medium hospitals have between 100 and 400 beds inclusively, and large hospitals have over 400 beds. The Personal Care Home (PCH) category carries no restrictions as to the number of available beds at the facility.

Comparing indices in these categories provides a good indication of relative energy use. However, the energy cost, energy consumption, and unit energy price indices do not in themselves differentiate between buildings in geographically high energy cost areas and those in low cost areas. Also, two facilities in the same area with the same energy costs typically show different energy consumption and cost indices. This is caused by different operating methods, building design, fuel types, etc.

1.3 Results

The results of the Facility Index Survey consisted of energy cost, energy consumption, and unit energy price indices for 160 health care facilities in Manitoba. For each category, the minimum, maximum, and average value of the indices were calculated. These data are summarised in Table 1.1. For a complete listing of the results for all facilities, the reader is directed to the Facility Index Survey report which will soon be available at Manitoba Energy and Mines and E.J. Faraci & Associates Ltd. in Winnipeg.

TABLE 1.1

SUMMARY OF RESULTS FROM FACILITY INDEX SURVEY

Facility Category	Energy Consumption Index			Energy Cost Index			Unit Energy Price Index		
	$kW.h/ft^2/yr$			$\$/ft^2/yr$			¢/kW.h		
	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max
Personal Care Home	13.53	48.20	96.75	0.48	1.22	2.60	1.23	2.68	4.40
Small Hospital	18.81	51.20	110.23	0.69	1.37	2.73	1.56	2.88	6.62
Medium Hospital	70.33	82.93	98.05	1.21	1.71	2.78	1.65	2.10	2.83
Large Hospital	60.23	90.57	125.44	0.99	1.45	2.02	1.54	1.61	1.64

1.4 Facility Selection

The indices calculated for each health care facility were reviewed to determine the facilities best suited for energy conservation under the Enerhosp programme. Facilities with high energy cost, energy consumption, and unit energy price indices were sought. Although these indices were the primary factors used in the facility selection, other criteria were considered: the PCH or hospital could not be attached to other buildings, the near-term facility plans could not include major changes, and at least one year of energy consumption data had to be available. Equitable and representative geographical distribution in the province was also an essential consideration.

In each category, two facilities were selected for detailed energy conservation studies:

Personal Care Homes

- St. Paul's Residence, The Pas
- Foyer Notre Dame, Notre Dame de Lourdes

Small Hospitals

- Johnson Memorial Hospital, Gimli
- Swan River Valley Hospital, Swan River

Medium Hospitals

- Concordia Hospital, Winnipeg
- Thompson General Hospital, Thompson

Large Hospitals

- Brandon General Hospital, Brandon
- Salvation Army Grace General Hospital, Winnipeg

A comparison of the energy indices for each of the eight selected facilities is given in Table 1.2.

Note must be made of the re-categorising of the Salvation Army Grace General Hospital. Three of the four Large Hospitals were eliminated from consideration. The Salvation Army Grace General Hospital was therefore included in the Large Hospital category since it was the largest in the Medium Hospital category.

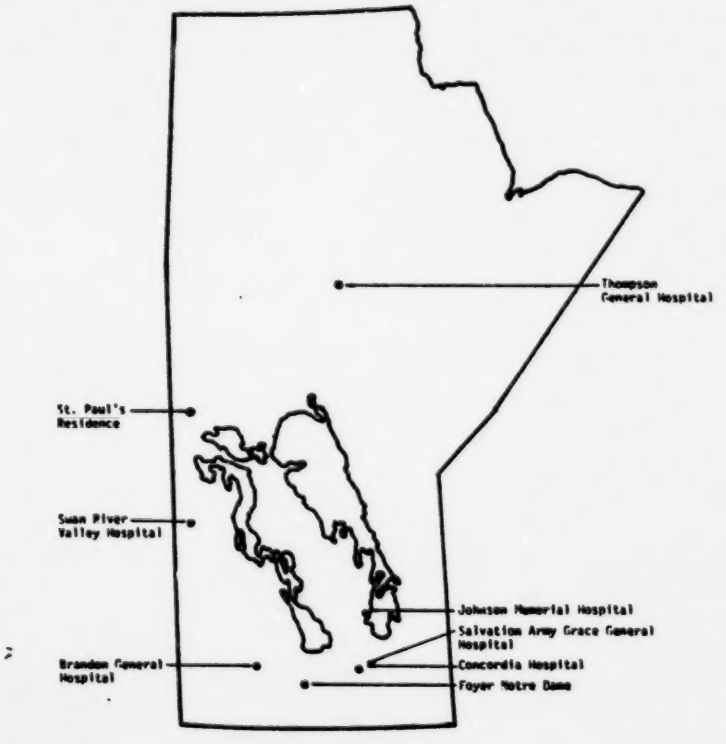


Figure 1.1 Geographical Distribution of Selected Facilities

TABLE 1.2

ENERGY INDICES OF THE SELECTED HEALTH CARE FACILITIES

Facility Category	Facility	Number of Beds	Gross Heated Floor Area (ft^2)	Energy Consumption Index ($kW.h/ft^2/yr$)	Energy Cost Index ($\$/ft^2/yr$)	Unit Energy Price Index (¢/kW.h)
Personal Care Home	St. Paul's Residence, The Pas	N/A	34 852	51.27	1.93	3.76
	Foyer Notre Dame, Notre Dame de Lourdes	N/A	27 997	65.54	1.78	2.72
Small Hospital	Johnson Memorial Hospital, Gimli	45	35 605	89.90	1.68	1.87
	Swan River Valley Hospital, Swan River	87	78 729	68.72	2.26	3.29
Medium Hospital	Concordia Hospital, Winnipeg	132	167 550	89.64	1.59	1.77
	Thompson General Hospital, Thompson	100	96 936	98.05	2.78	2.84
Large Hospital	Brandon General Hospital, Brandon	433	310 330	125.44	2.02	1.61
	Salvation Army Grace General Hospital, Winnipeg	302*	330 340	92.26	1.52	1.65

* It was necessary to re-categorise this facility into the Large Hospital category. (See Section 1.4)

TASK II: IMPLEMENTING THE ENERGY CONSERVATION TECHNIQUES

2.0 ENERGY CONSERVATION TECHNIQUES

In an effort to improve the energy efficiency of the building systems, a series of Energy Conservation Techniques (ECTs) was evaluated for each facility with respect to practicality and economic feasibility. Practical constraints included safety, comfort, aesthetics and operational consequences. Economic evaluation was based on simple payback:

$$\text{simple payback} = \frac{\text{implementation cost}}{\text{annual cost saving}} .$$

Measures showing a payback of five years or less generally received a positive recommendation from the consultant. Choosing which ECTs to implement was further influenced by budget constraints and individual facility needs and preferences.

As explained in Task I: Assessing the Facilities, two health care facilities were chosen from each of the four defined categories. The eight energy conservation retrofits are described below. Note that in the summary table for each retrofit, the individual expected savings cannot generally be summed directly to arrive at the overall retrofit savings since implemented ECTs often reduce the savings that other implemented ECTs can yield. Detailed ECT calculations can be obtained by contacting Manitoba Energy and Mines or E.J. Faraci & Associates Ltd.

2.1 Personal Care Homes

St. Paul's Residence in The Pas and Foyer Notre Dame in Notre Dame de Lourdes were selected in this category. Both facilities have their own utility metering and both have relatively high energy cost and consumption indices as compared to the other 83 personal care homes considered. Foyer Notre Dame is located in southern Manitoba, giving perspective to the differences in energy usage and cost for different areas of the province.

2.1.1 St. Paul's Residence, The Pas

2.1.1.1 Retrofit Description

The energy conservation retrofit at the St. Paul's Residence will reduce its annual energy consumption by 28% and its annual energy cost by 29%. The retrofit components are summarised in Table 2.1 and the overall savings are illustrated in Figure 2.1. Brief ECT descriptions are given below.

Individual Room Thermostats

The building hot water heating system was divided into large north and south zones, each managed by an indoor/outdoor temperature controller. Room temperature was only marginally adjustable with awkward convector hand valves, and windows were often opened to combat overheating. Individual thermostatically controlled convector valves were installed in each room by the facility maintenance staff.

General Ventilation Time-Clock Control

The general ventilation system operated continuously in both the heating and cooling seasons. An automatic day/night time-clock was installed to shut down the system for eight hours each night of the heating season. The air quality is being monitored to assure that this is the appropriate shut down period.

Kitchen Exhaust Time-Clock Control

The kitchen exhaust fan operated thirteen hours each day even though the kitchen was used only for light meals and snacks. A two hour time-clock control was added to the on-off switch to provide ventilation when necessary but to assure that the system is off when not needed. The run time of the ventilation system was reduced by about half.

Infiltration Reduction

A computer heat balance analysis of the structure indicated that primary energy infiltration losses totalled 160 000 kWh/year or about 25% of the annual heating load. Daylight was visible around many door casements, and window caulking was badly deteriorated. A caulking, sealing and weatherstripping program was implemented which is estimated to have reduced infiltration by 20%.

Insulation of Stairway Windows

Two stairways, each with five windows were lighted continuously. The windows resulted in an unnecessary heat loss. The windows were filled in and insulated to increase their insulation level to RSI 3.5 from RSI 0.35. As an alternative to this measure, photocell control of the lights was investigated. This proved to be a less attractive method of conserving energy in this case.

Low Flow Shower Heads

Flow restrictors were placed on the shower heads to reduce the overall water consumption by about 40%.

Main Floor Temperature Setback

The main floor of the residence comprises the kitchen, dining areas, administrative offices, the chapel, and meeting rooms. None of these areas was occupied 24 hours per day. Automatic seven-day night setback thermostats were installed to reduce the temperature to 13^{o}C during unoccupied periods.

2.1.1.2 Unimplemented ECTs

Several conservation measures were investigated but not carried out. These are summarised in Table 2.2 along with the reasons for their not being implemented. A brief description of each is given below.

Hot Water Conversion

The kitchen make-up air is heated by propane. Since a conversion was planned to heat the hot water with fuel oil, a conversion to hot water heating of the kitchen makeup air was examined. This measure would not reduce energy consumption but would reduce energy cost.

Car Plug Thermostat Control

The plug receptacles in the facility parking lot are controlled by an automatic timer. It was proposed that a thermostat be installed to work in conjunction with the timer. The thermostat would cause the plugs to turn off if the temperature rose above a preset point of $-7^{o}C$.

Fluorescent Lighting Conversion

Consideration was given to converting all thirty incandescent 100 Watt lights in the common room/eating area to 40 Watt fixtures.

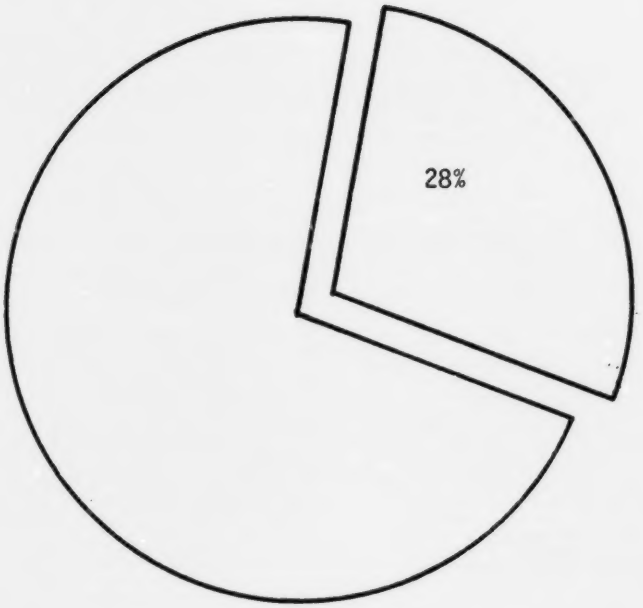
2.1.1.3 Conclusions

This facility retrofit has a remarkably low simple payback period. The costs were kept low because most of the required work was done internally by the hospital staff. Any hospital facility which takes this course is, in the end, making more money available to the facility. Further energy conservation or an increased level of service can result.

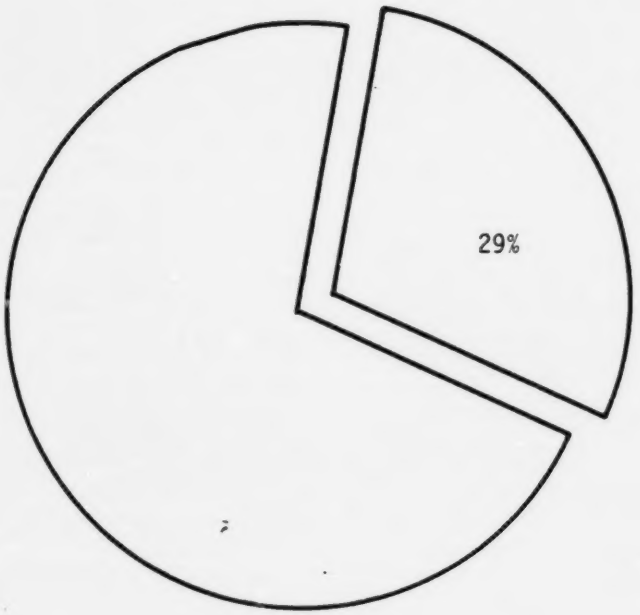
TABLE 2.1

RETROFIT DESCRIPTION- ST. PAUL'S RESIDENCE, THE PAS

ENERGY CONSERVATION TECHNIQUE	ACTUAL IMPLEMENTATION COST ($)	EXPECTED ENERGY SAVING (kWh/yr)	EXPECTED COST SAVING ($/yr)	SIMPLE PAYBACK (YEARS)
Individual Room Thermostats	13 000	320 000	12 000	1.1
General Ventilation Time-Clock Control	1 000	83 000	3 100	0.4
Kitchen Exhaust Time-Clock Control	1 000	49 000	1 800	0.6
Infiltration Reduction	3 000	40 000	1 500	2.0
Stairway Windows' Insulation	2 000	5 300	270	7.5
Low Flow Shower Heads	45	>1 600	>45	<1.0
Main Floor Temperature Setback	2 000	44 000	1 700	1.2
OVERALL RETROFIT	22 000	500 000	19 000	1.2



Annual Energy
Consumption Saving



Annual Energy
Cost Saving

FIGURE 2.1
ENERGY AND COST SAVINGS - ST. PAUL'S RESIDENCE, THE PAS

TABLE 2.2

UNIMPLEMENTED ECTS - ST. PAUL'S RESIDENCE, THE PAS

ENERGY CONSERVATION TECHNIQUE	ESTIMATED IMPLEMENTATION COST ($)	ESTIMATED ENERGY SAVING (kWh/yr)	ESTIMATED COST SAVING ($/yr)	SIMPLE PAYBACK (YEARS)	REASON FOR NOT BEING IMPLEMENTED UNDER ENERHOSP
Hot Water Conversion	4 000	0	600	6.7	Simple payback is too high
Car Plug Thermostat Control	250	3 000	40	6.4	Simple payback is too high
Fluorescent Lighting Conversion	2 000	1 800	45	46.	Simple payback is too high

2.1.2 Foyer Notre Dame, Notre Dame de Lourdes

2.1.2.1 Retrofit Description

The energy conservation retrofit at the Foyer Notre Dame will reduce its annual energy consumption by 22% and its annual energy cost by 24%. The retrofit components are summarised in Table 2.3 and the overall savings are illustrated in Figure 2.2. Brief ECT descriptions are given below.

Hot Water Storage Increase

Domestic hot water was provided from a low pressure oil-fired boiler, operating at a low seasonal efficiency. This system was modified to use an existing 54 kW electric booster to provide the domestic hot water. The present 1820 l of storage was increased by using a second existing 1820 l storage tank and by installing four new 455 l storage tanks.

Fume Hood Exhaust Time-Clock Control

A kitchen hood exhaust fan of 1130 L/S (2400 cfm) removes fumes and odour from the range and fryer. This fan ran unnecessarily about 1/3 of its operating time. A delay timer has been installed so that the fan turns off within ten minutes of the range being turned off.

Electric Boiler and Dryer

The laundry room contained two electric dryers and one steam dryer. A high electrical demand occured between 8:00 a.m. and 4:00 p.m. because of the electric dryers. A 144 kVA electric boiler and a four stage demand controller were added to the heating system to use inexpensive off-peak electrical power. The steam dryer was replaced by an electric dryer so that the oil

boiler (which supplied the steam dryer) can be completely shut off for the summer period. As an attendant result of this ECT, the facility has a secondary heating system.

Individual Room Temperature Control

In the old section of the facility, there was no thermostatic control of the baseboard heaters. The resulting overheating caused the occupants to open windows. This situation was corrected by installing individual thermostatic radiator valves on each baseboard heater. Not only does this reduce heating costs but individual zone control is achieved.

Convertor and Piping Insulation

The steam convertor in the boiler room was reinsulated. Its insulation had deteriorated contributing to the low efficiency of the oil boiler system. Also, some hot water piping was insulated.

2.1.2.2 Unimplemented ECTS

Several conservation measures were investigated but not carried out. These are summarised in Table 2.4 along with the reasons for their not being implemented. A brief description of each is given below.

Laundry Dryer Exhaust Air Heat Recovery

The three dryers use indoor air and exhaust directly to outside. It was proposed that the dryer air be brought in from outside and heat be recovered from the exhausted air. This would reduce infiltration and save energy. An extensive, labour-intensive filtering system would have been required.

Freezer Compressor Relocation

The compressor units of the walk-in freezers are located in the boiler room where the temperature is about 95°F. Relocating the units to the crawlspace (65°F) was considered to increase their life and improve their efficiency.

Grey Water Heat Recovery

The laundry consumes over 2 million litres of water annually. The grey water (waste water) goes to the drain at 33°C. A grey water heat recovery system was examined, consisting of a preheat tank, a heat exchanger, piping, and controls.

Laundry Dryer Optimisation

It was suggested that the electric dryers be converted to steam dryers to reduce the excessive electrical demand. This was to be considered only if the proposed electric boiler was not installed.

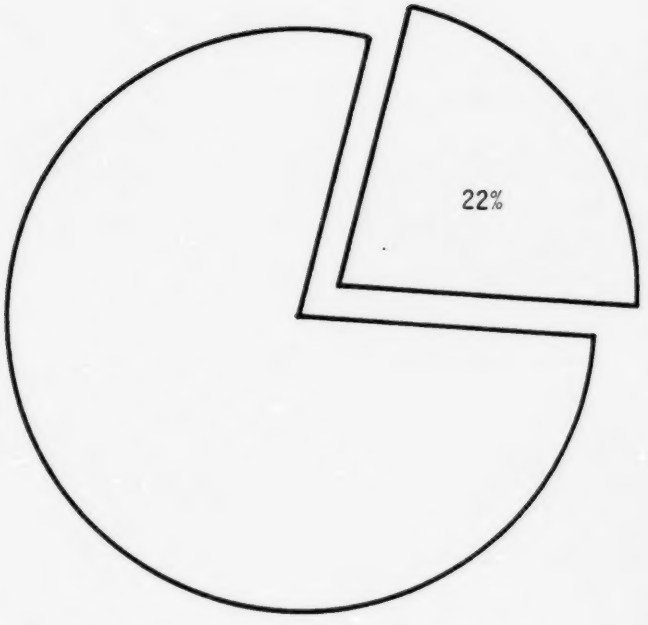
2.1.2.3 Conclusions

The most expensive part of this facility's retrofit was the electric boiler installation. In itself, an electric boiler replacing an inefficient oil boiler typically gives a short payback period. However, in this facility as with the Salvation Army Grace General Hospital, the electrical service had to be increased extensively to accommodate the electric boiler. Though an electric boiler and demand controller installation is an effective way of making use of inexpensive off-peak electric power, its economic feasibility is not always assured since it depends on the required increase in electrical service.

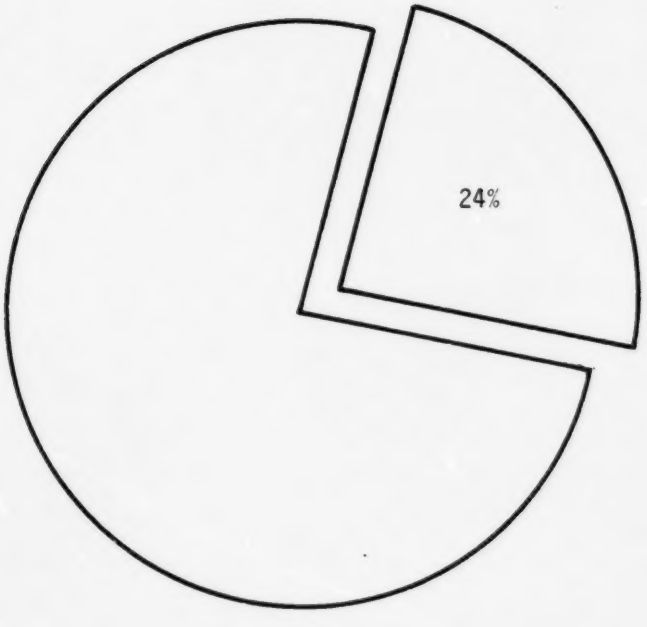
TABLE 2.3

RETROFIT DESCRIPTION - FOYER NOTRE DAME, NOTRE DAME DE LOURDES

ENERGY CONSERVATION TECHNIQUE	ACTUAL IMPLEMENTATION COST ($)	EXPECTED ENERGY SAVING (kWh/yr)	EXPECTED COST SAVING ($/yr)	SIMPLE PAYBACK (YEARS)
Hot Water Storage Increase	9 930	95 000	2 200	4.5
Fume Hood Exhaust Time-Clock Control	75	19 000	500	0.2
Electric Boiler and Dryer	30 000	210 000	5 700	5.3
Individual Room Temperature Control	8 850	180 000	3 600	2.5
Convertor and Piping Insulation	800	6 800	790	1.0
OVERALL RETROFIT	49 700	400 000	12 000	4.1



Annual Energy
Consumption Saving



Annual Energy
Cost Saving

FIGURE 2.2

ENERGY AND COST SAVINGS - FOYER NOTRE DAME, NOTRE DAME DE LOURDES

TABLE 2.4

UNIMPLEMENTED ECTS - FOYER NOTRE DAME, NOTRE DAME DE LOURDES

ENERGY CONSERVATION TECHNIQUE	ESTIMATED IMPLEMENTATION COST ($)	ESTIMATED ENERGY SAVING (kWh/yr)	ESTIMATED COST SAVING ($/yr)	SIMPLE PAYBACK (YEARS)	REASON FOR NOT BEING IMPLEMENTED UNDER ENERHOSP
Laundry Dryer Exhaust Air Heat Recovery	15 000	54 000	1 400	11.	Simple payback is too high
Freezer Compressor Relocation	1 000	3 900	52	19.	Simple payback is too high
Greywater Heat Recovery	15 000	26 000	980	15.	Simple payback is too high
Laundry Dryer Optimisation	5 000	-35 100	1 600	3.1	Electric boiler was installed

2.2 Small Hospitals

The Small Hospital category consists of hospitals with less than 100 beds. The Johnson Memorial Hospital in Gimli and the Swan River Valley Hospital in Swan River were selected in this category.

2.2.1 Johnson Memorial Hospital, Gimli

2.2.1.1 Retrofit Description

The energy conservation retrofit at the Johnson Memorial Hospital will reduce its annual energy consumption by 9.3% and its annual energy cost by 8.7%. The retrofit has an overall payback of 4.7 years. The retrofit components are summarised in Table 2.5 and the overall savings are illustrated in Figure 2.3. Brief ECT descriptions are given below.

Energy Management System

A computerised energy management system was installed to control the hospital's heating, ventilating and air conditioning systems. This system uses a microprocessor in place of mechanical or electrical controls. The microprocessor receives information from temperature and humidity sensors and resets fresh air volumes and supply air temperatures to meet changing load conditions, resulting in a more efficient use of energy.

This energy management system encompassed six of the other ECTs studies. These include night shutdown of kitchen area and administration area air handling units, cycling of car plug receptacles, implementation of an economiser cycle to benefit from free cooling, resetting of administration and ward air handling units as conditions change, and summer shutdown of perimeter

radiation and air preheat pump.

Domestic Hot Water Mixing System

Prior to the Enerhosp study, the facility reduced its natural gas-fired domestic hot water temperature to 54.4°C (130°F) in an attempt to conserve energy. Unfortunately, this necessitated the planned installation of a 12 kW electric booster heater for the high temperature process supply. The Enerhosp consultant projected that it would be more economical to raise the gas heating system to a process temperature of 76.7°C (170°F) and then supply domestic water at 49°C (120°F) from a cold water mixing station.

2.2.1.2 Unimplemented ECTS

Several conservation measures were investigated but not carried out. These are summarised in Table 2.6 along with the reasons for their not being implemented. A brief description of each is given below.

Ward Area Exhaust Air Heat Recovery

The ward area ventilation system runs continuously. It was proposed that a glycol run around system be installed to recover the heat in the exhaust air and use it to preheat the incoming fresh air.

Administration Area Exhaust Air Heat Recovery

The administration area ventilation system ran for 12 hours each day. An exhaust air heat recovery system was studied, similar to the ward area ventilation system explained earlier in this section.

Old Roof Insulation Upgrading

The roof of the hospital's older section was built of wood frame construction with asphalt shingles. It has an insulation value of RSI 2.0. Consideration was given to raising this to RSI 7.0 by laying batts of

fibreglass insulation over the existing insulation.

New Roof Insulation Upgrading

The roof of the hospital's newer section is constructed of a metal deck, rigid insulation, and built-up roofing, giving an insulation value of RSI 1.3. Consideration was given to raising this to RSI 7.0 but it was determined that it is excessively expensive to raise the insulation level of this type of roofing.

Power Factor Correction

Study was given to the practicality of improving the power factor of the chiller compressor and the main electrical service from 90% to 95%.

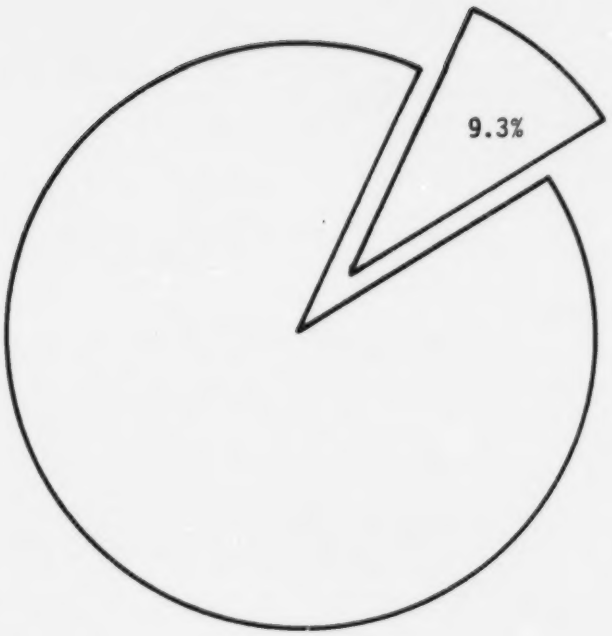
2.2.1.3 Conclusions

All measures put into place at the Johnson Memorial Hospital worked to improve control over the heating, ventilating, and air conditioning systems. Many of the original ECTs were implemented through the energy management system. Control systems can reduce annual energy costs while maintaining or even improving the quality of the building environment.

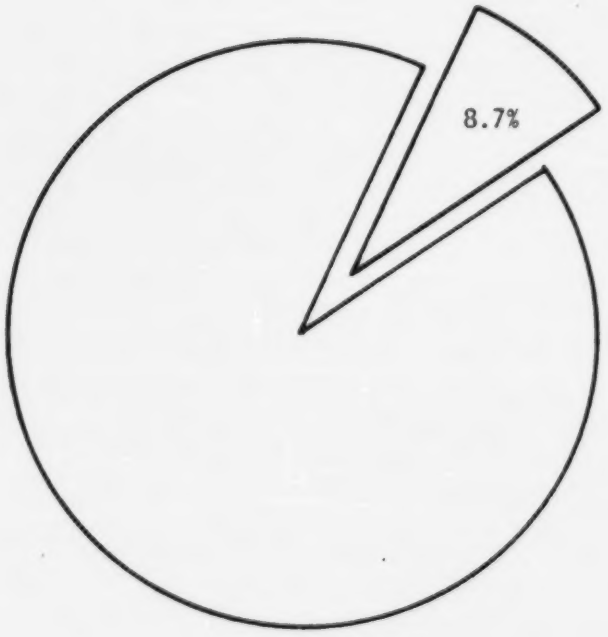
TABLE 2.5

RETROFIT DESCRIPTION - JOHNSON MEMORIAL HOSPITAL, GIMLI

ENERGY CONSERVATION TECHNIQUE	ACTUAL IMPLEMENTATION COST ($)	EXPECTED ENERGY SAVING (kWh/yr)	EXPECTED COST SAVING ($/yr)	SIMPLE PAYBACK (YEARS)
Energy Management System	23 700	310 000	4 900	4.8
Domestic Hot Water Mixing System	1 800	-11 000	510	3.5
OVERALL RETROFIT	25 500	300 000	5 400	4.7



Annual Energy
Consumption Saving



Annual Energy
Cost Saving

FIGURE 2.3

ENERGY AND COST SAVINGS - JOHNSON MEMORIAL HOSPITAL, GIMLI

TABLE 2.6

UNIMPLEMENTED ECTS - JOHNSON MEMORIAL HOSPITAL, GIMLI

ENERGY CONSERVATION TECHNIQUE	ESTIMATED IMPLEMENTATION COST ($)	ESTIMATED ENERGY SAVING (kWh/yr)	ESTIMATED COST SAVING ($/yr)	SIMPLE PAYBACK (YEARS)	REASON FOR NOT BEING IMPLEMENTED UNDER ENERHOSP
Ward Area Exhaust Air Heat Recovery	15 000	150 000	2 600	5.8	Simple payback is too high
Administration Area Exhaust Air Heat Recovery	15 000	86 000	1 400	11.	Simple payback is too high
Old Roof Insulation Upgrading	3 000	16 000	360	8.3	Simple payback is too high
New Roof Insulation Upgrading	76 000	230 000	5 200	15	Simple payback is too high
Power Factor Correction	5 000	0	570	8.8	Simple payback is too high

2.2.2 Swan River Valley Hospital, Swan River

2.2.2.1 Retrofit Description

The energy conservation retrofit at the Swan River Valley Hospital will reduce both its annual energy consumption and its annual energy cost by 16%. The retrofit has an overall payback of 1.3 years. The retrofit components are summarised in Table 2.7 and the overall savings are illustrated in Figure 2.4. Brief ECT descriptions are given below.

Multizone Unit Time-Clock Control and Two-Speed Conversion

A single multizone air handling system supplies the basement, main, and second floors with 100% outside air. Most of these areas house support services and are consequently unoccupied evenings and weekends. Prior to the Enerhosp study, the air system operated at full volume, 24 hours per day. Supply and exhaust fans were converted to two-speed operation and zone dampers with time-clock control were installed. This equipment allowed the air supply in unoccupied zones to be shut down without affecting operation in occupied areas. During unoccupied periods (8:00 p.m. - 6:00 a.m. on weekdays, 24 hours on weekends), total ventilation is reduced from 3 540 L/s (7 500 cfm) to 2100 L/s (4 450 cfm).

Return Air System Retrofit

The entire facility had only one return air duct. This system was modified to return a total of 944 L/s (2 000 cfm) of indoor air from the basement. An existing general exhaust air duct in the basement was modified to be a return air plenum. A return air fan with a time-clock control was installed to return the appropriate volume of air to the mechanical room.

Administration Unit Time-Clock Control

Prior to the Enerhosp study, the administration air handling unit ran continuously, supplying 2 180 L/s (4 620 cfm) of air about 25% of which was return air. However, most of the office use is limited to 8:00 a.m. to 5:00 p.m. during weekdays. A time-clock was installed to limit the unit's operation to the occupied period. Some ductwork modifications were required.

Cafeteria/Kitchen Unit Time-Clock Control

The kitchen and cafeteria air handling system exhausts 2 490 L/s (5 280 cfm) with a corresponding supply of 2 190 L/s (4 650 cfm). Prior to the Enerhosp study, this system was operating 24 hours per day. Time-clocks were installed on the supply and exhaust fans to limit operation to the occupancy period of 14 hours per day.

2.2.2.2 Unimplemented ECTS

Several conservation measures were investigated but not carried out. These are summarised in Table 2.8. A brief description of each is given below.

Heat Recovery in Old Section

Washroom exhaust in the old section of the facility discharges 3 540 L/s (7 500 cfm) continuously. Study was given to the installation of a glycol run around heat recovery system to preheat the makeup air with the heat recovered from the exhaust air.

Heat Recovery in New Section

A glycol run around heat recovery system was considered for the operating room and washroom exhaust systems in the new section of the facility. The makeup air shaft and the exhaust air plenum are only about 100 feet apart facilitating the installation of such a recovery system.

Electric Boiler

The old and new sections of the facility are heated by two propane-fired steam boilers. A 180 kW electric steam boiler can be installed in the old section to offset the propane consumption with electricity.

Variable Speed Conversion

The operating room ventilation unit operates continuously supplying 3120 L/s (6 620 cfm) of 100% outside air yet the spaces it serves are not continuously used. Consideration was given to installing a variable speed drive and motorised dampers interlocked with the lightswitches of the spaces. A pressure switch would sense the increased pressure causing the variable speed drive to slow down the fan.

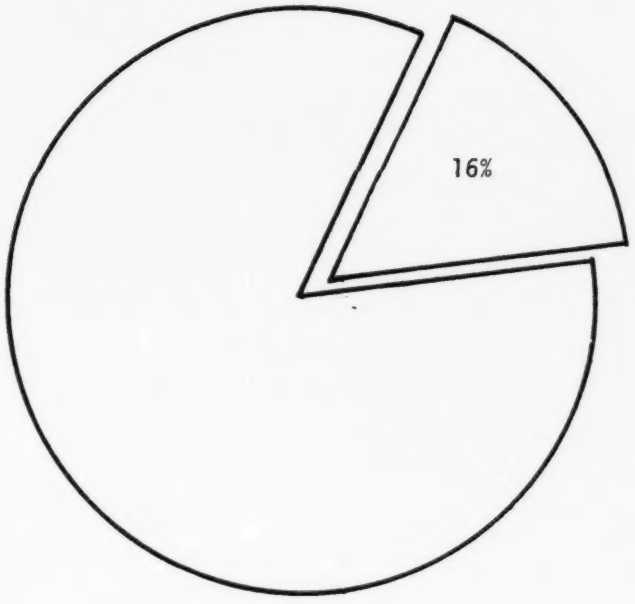
2.2.2.3 Conclusions

This facility's retrofit demonstrates the high cost of ventilation. Prior to the Enerhosp study, many spaces were ventilated needlessly throughout unoccupied periods. Such unnecessary or excessive ventilation should always be avoided provided codes and accepted standards of ventilation requirements continue to be met. In this facility's case, the payback periods were particularly short because the facility uses propane, a very expensive energy source.

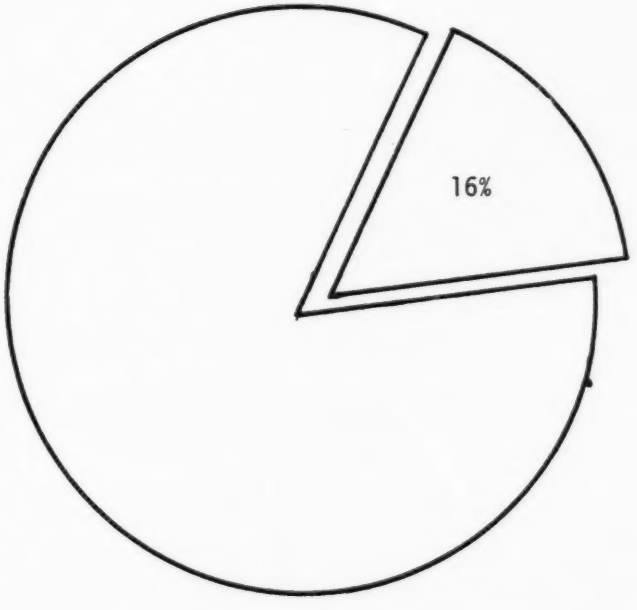
TABLE 2.7

RETROFIT DESCRIPTION - SWAN RIVER VALLEY HOSPITAL, SWAN RIVER

ENERGY CONSERVATION TECHNIQUE	ACTUAL IMPLEMENTATION COST ($)	EXPECTED ENERGY SAVING (kWh/yr)	EXPECTED COST SAVING ($/yr)	SIMPLE PAYBACK (YEARS)
Multizone Unit Time-Clock Control and Two-Speed Conversion	20 400	240 000	7 900	2.6
Return Air System Retrofit	8 000	66 000	2 200	3.7
Administration Unit Time-Clock Control	5 000	310 000	10 000	0.5
Cafeteria/Kitchen Unit Time-Clock Control	2 500	260 000	8 600	0.3
OVERALL RETROFIT	35 900	850 000	28 000	1.3



Annual Energy
Consumption Saving



Annual Energy
Cost Saving

FIGURE 2.4

ENERGY AND COST SAVINGS - SWAN RIVER VALLEY HOSPITAL, SWAN RIVER

TABLE 2.8

UNIMPLEMENTED ECTS - SWAN RIVER VALLEY HOSPITAL, SWAN RIVER

ENERGY CONSERVATION TECHNIQUE	ESTIMATED IMPLEMENTATION COST ($)	ESTIMATED ENERGY SAVING (kWh/yr)	ESTIMATED COST SAVING ($/yr)	SIMPLE PAYBACK (YEARS)	REASON FOR NOT BEING IMPLEMENTED UNDER ENERHOSP
Heat Recovery in Old Section	23 000	320 000	11 000	2.1	Budget Restrictions
Heat Recovery in New Section	56 000	700 000	23 000	2.4	Budget Restrictions
Electric Boiler	25 000	210 000	9 800	2.6	Budget Restrictions
Variable Speed Conversion	30 000	210 000	6 800	4.4	Budget Restrictions

2.3 Medium Hospitals

The Medium Hospital category consists of hospitals with one hundred or more beds and with four hundred or less beds. The Concordia Hospital in Winnipeg and the Thompson General Hospital in Thompson were selected in this category.

2.3.1 Concordia Hospital, Winnipeg

2.3.1.1 Retrofit Description

The energy conservation retrofit at the Concordia Hospital will reduce the facility's annual energy consumption by 8.0% and annual energy cost by 7.5%. The retrofit has an overall payback of 6.1 years. The retrofit components are summarised in Table 2.9 and the overall savings are illustrated in Figure 2.5. Brief ECT descriptions are given below.

Electric Boiler

Prior to the Enerhosp study, there existed a difference of over 350 kVA between night and day electrical demand at this facility. An electric boiler of 350 kW capacity was installed to operate during off-peak hours, thereby avoiding the electrical demand charges that normally make electric heating prohibitively expensive.

General Exhaust Air Heat Recovery

A glycol run-around heat recovery system was installed to recover heat from general exhaust air. Two side by side ducts were consolidated into one so that one exhaust air reclaim coil would suffice. The recovered heat is used to preheat the boiler room ventilation air.

Boiler Oxygen Control

The primary 500 hp. low pressure heating boiler accomodates widely fluctuating loads, rendering periodic efficiency adjustment difficult and ineffective. An automatic combustion control system was installed, resulting in an expected saving of 3% of the annual natural gas consumption. Minimal boiler modification was required.

Enthalpy Control

The facility mixed-air handling systems were designed for summer changeover based on chilled water sensing. Enthalpy control for four systems was installed as a function of the existing building automation system. Costs included sensor and software installation.

Boiler Scheduling

A 500 hp. heating boiler was operated throughout the summer to accomodate a very small low pressure steam load. This low-fire operation resulted in a relatively low estimated efficiency of 60%. Evaluation indicated that the existing 80 hp. high pressure process boiler would have sufficient capacity to handle both high and low pressure summer steam loads. A pressure reducing station was installed between the high and low pressure headers to allow this operation.

2.3.1.2 Unimplemented ECTS

Several conservation measures were investigated but not carried out under Enerhosp. These are summarised in Table 2.10 along with the reasons for their not being implemented. A brief description of each is given below.

Roof Insulation Upgrading

The hospital roof has a low insulation value of RSI 1.2 (R7) and is a source of a great deal of heat loss. Consideration was given to upgrading the roof insulation level to RSI 7.0 (R40).

Kitchen Exhaust Air Heat Recovery

A glycol run-around heat recovery system was proposed for the facility's kitchen ventilation system. This air handling system runs 15 hours per day delivering 100% outside air. The heat recovered from the 3 920 L/s (8 300 cfm) range exhaust was to be used to preheat the incoming makeup air. This proposed heat recovery system required a washdown system on the exhaust air coil.

Power Factor Correction

Study was given to the practicality of improving the power factor of the main electrical service from 90% to 95%.

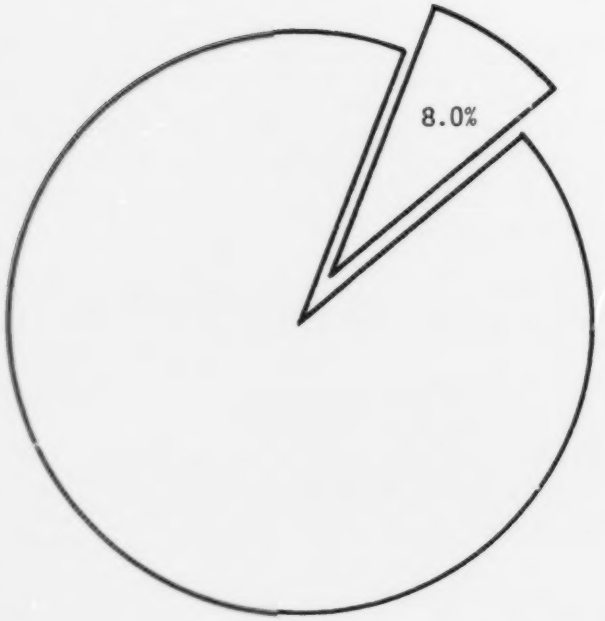
2.3.1.3 Conclusions

This retrofit had the highest payback period of all eight retrofits. The high payback period was caused mainly by an unsatisfactory tendering process. The response was poor and the quotes reflected this. Tendering during the Christmas season should be avoided if possible.

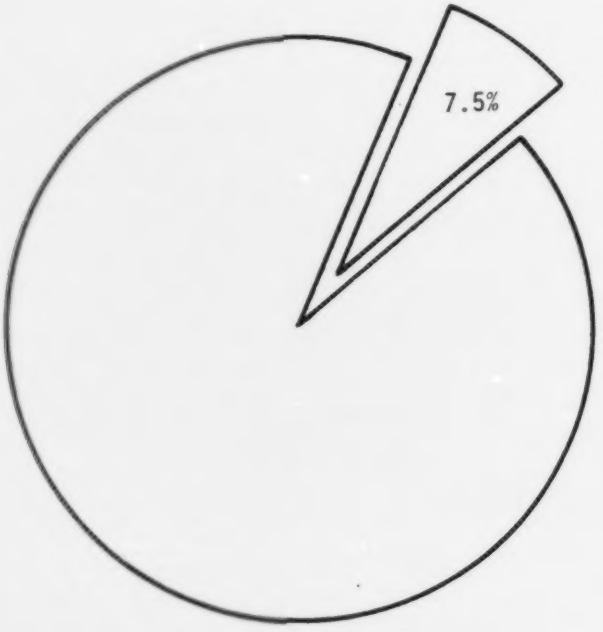
TABLE 2.9

RETROFIT DESCRIPTION - CONCORDIA HOSPITAL, WINNIPEG

ENERGY CONSERVATION TECHNIQUE	ACTUAL IMPLEMENTATION COST ($)	EXPECTED ENERGY SAVING (kWh/yr)	EXPECTED COST SAVING ($/yr)	SIMPLE PAYBACK (YEARS)
Electric Boiler	51 800	390 000	6 700	7.7
General Exhaust Air Heat Recovery	23 500	360 000	5 100	4.6
Boiler Oxygen Control	32 300	300 000	4 200	7.7
Enthalpy Control	6 420	90 000	2 500	2.6
Boiler Scheduling	6 890	150 000	2 200	3.1
OVERALL RETROFIT	121 000	1 200 000	20 000	6.1



Annual Energy
Consumption Saving



Annual Energy
Cost Saving

FIGURE 2.5

ENERGY AND COST SAVINGS - CONCORDIA HOSPITAL, WINNIPEG

TABLE 2.10

UNIMPLEMENTED ECTS - CONCORDIA HOSPITAL, WINNIPEG

ENERGY CONSERVATION TECHNIQUE	ESTIMATED IMPLEMENTATION COST ($)	ESTIMATED ENERGY SAVING (kWh/yr)	ESTIMATED COST SAVING ($/yr)	SIMPLE PAYBACK (YEARS)	REASON FOR NOT BEING IMPLEMENTED UNDER ENERHOSP
Roof Insulation Up-grading	130 000	600 000	8 600	15.	Simple payback is too high
Kitchen Exhaust Air Heat Recovery	31 000	360 000	5 100	6.1	Simple payback is too high
Power Factor Correction	45 000	0	2 900	16.	Simple payback is too high

2.3.2 Thompson General Hospital, Thompson

2.3.2.1 Retrofit Description

The energy conservation retrofit at the Thompson General Hospital will reduce the facility's annual energy consumption by 7.0% and annual energy cost by 7.8%. The retrofit has an overall payback of 5.1 years. The retrofit components are summarised in Table 2.11 and the overall savings are illustrated in Figure 2.6. Brief ECT descriptions are given below.

Energy Management System

A computerised energy management system was installed to control the hospital's heating, ventilating, and air conditioning systems. This system uses a microprocessor in place of mechanical or electrical controls. The microprocessor receives information from temperature and humidity sensors and resets fresh air volumes and supply air temperatures to meet changing load conditions, resulting in a more efficient use of energy. Other functions include optimum start/stop, cycling of equipment, and full system monitoring.

Boiler Room Insulation

Two boilers, a convertor, and some piping in the boiler room can be economically insulated. This measure is being implemented by the hospital maintenance staff.

Power Factor Correction

It was calculated that the facility meter had a power factor of 81%. A staged capacitor controlled by an existing building automation system was installed to correct the power factor to 95%. Required modifications to the existing electrical service were minimal.

Operating Room Exhaust Air Heat Recovery

The operating theatre air handling system supplies 2 560 L/s (5 425 cfm) of outside air and exhausts 2 150 L/s (4 550 cfm). Operation is 24 hours per day. A glycol run-around system was installed between the supply and exhaust ducts. The installation required short pipe runs and presented little difficulty.

Boiler Flue Gas Analyser

An analysis of boiler flue gases can be used to set up correct boiler adjustment. A portable flue gas analyser was purchased to manually adjust the boilers, as the seasons change.

Electric Dryer Conversion

A conversion to electric dryers from the present propane-fired dryers will be carried out by the facility maintenance staff. This measure was worthwhile because of the future installation of an off-peak electric boiler. The combined effect of these devices lowers the electrical energy cost well below that of propane.

In-House Techniques

Several small ECTs were suggested that are slowly being implemented by the facility maintenance staff, depending on the remaining available money in the Enerhosp budget for this facility. These include reconnecting radiator valve thermostats, installing car plug temperature control, delamping outside lights, and turning off interior zone lights when not required.

2.3.2.2 Unimplemented ECTs

Several conservation measures were investigated but not carried out under Enerhosp. These are summarised in Table 2.12 along with the reasons for their not being

implemented. A brief description of each is given below.

Electric Boiler

A 1 000 kW electric boiler was proposed to make use of the low cost of off-peak heating with electricity. The facility, however, was already in the process of installing a 300 kW unit. Also, the $65 000 cost could not be accommodated within the budget. For these two reasons, this electric boiler was rejected.

Wall Insulation Upgrading

The walls of the old section of the hospital have poor insulation, a poor vapour barrier, and cracks around the existing stainless steel panels. Upgrading these walls by adding insulated metal panels and a vapour barrier was considered.

Incinerator Heat Recovery

The hospital has an incinerator which is used about 45 times per year. Consideration was given to recovering the heat from the flue gases by redirecting them through an existing oil boiler. Major modifications would be required.

Incinerator Fuel Conversion

The incinerator can be modified to burn oil instead of propane. The conversion would require new controls, and changes made to the fuel line, ignition burner, main burner and stack burner.

Kitchen Exhaust Air Heat Recovery

A glycol run-around heat recovery system was proposed for the facility's kitchen ventilation system. This air handling system runs 12 hours per day delivering 100% outside air. The heat recovered from the 4 720

L/s (10 000 cfm) of exhaust air was to be used to preheat the incoming 4 270 L/s (9 050 cfm) of supply air. This proposed heat recovery system required a washdown system on the exhaust coil.

Propane Dryer Heat Recovery

The propane dryers can be modified to recirculate 30% of the exhaust air, reducing the energy bill by about 25%. All new propane dryers must be designed this way.

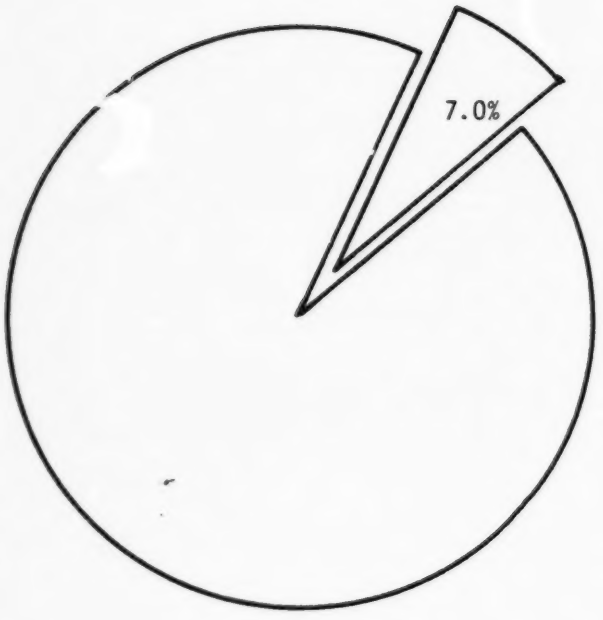
2.3.2.3 Conclusions

Prior to the Enerhosp study, this facility's staff was aware of many possible energy conservation measures but these lacked financial support. A program had already been put into place to reduce the facility's oil dependency through increased electricity use. The payback period for the energy management system was longer than usual because of the high level of manual control provided by the maintenance staff. The energy management system has enabled this facility to carry out these and other control improvements more efficiently and will accommodate any future expansion plans. Overall, the Enerhosp programme was an overdue helping hand for this well-run facility.

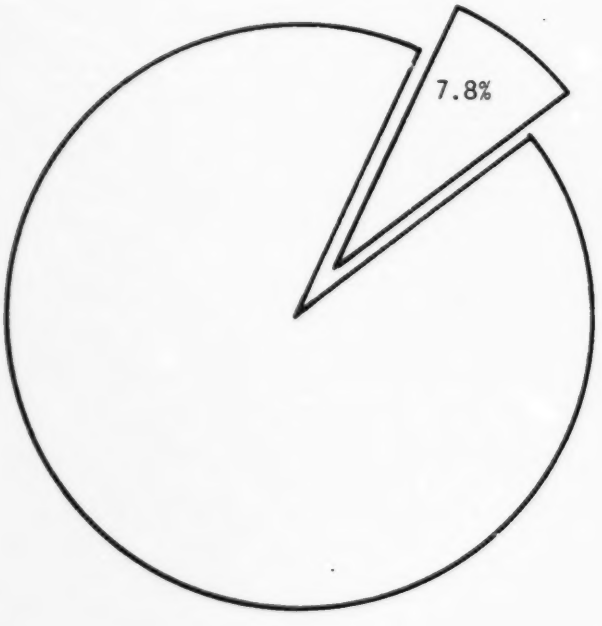
TABLE 2.11

RETROFIT DESCRIPTION - THOMPSON GENERAL HOSPITAL, THOMPSON

ENERGY CONSERVATION TECHNIQUE	ACTUAL IMPLEMENTATION COST ($)	EXPECTED ENERGY SAVING (kWh/yr)	EXPECTED COST SAVING ($/yr)	SIMPLE PAYBACK (YEARS)
Energy Management System	42 000	150 000	4 400	9.5
Boiler Room Insulation	5 000	35 000	1 000	5.0
Power Factor Correction	22 000	0	4 200	5.2
Operating Room Exhaust Air Heat Recovery	23 500	310 000	8 600	2.7
Boiler Flue Gas Analyser	3 500	190 000	530	6.6
Electric Dryer Conversion	17 000	26 000	4 000	4.3
In-House Techniques	N/A	unavailable	unavailable	< 5.0
OVERALL RETROFIT	113 000	700 000	22 000	5.1



Annual Energy
Consumption Saving



Annual Energy
Cost Saving

FIGURE 2.6

ENERGY AND COST SAVINGS - THOMPSON GENERAL HOSPITAL, THOMPSON

TABLE 2.12

UNIMPLEMENTED ECTS - THOMPSON GENERAL HOSPITAL, THOMPSON

ENERGY CONSERVATION TECHNIQUE	ESTIMATED IMPLEMENTATION COST ($)	ESTIMATED ENERGY SAVING (kWh/yr)	ESTIMATED COST SAVING ($/yr)	SIMPLE PAYBACK (YEARS)	REASON FOR NOT BEING IMPLEMENTED UNDER ENERHOSP
Electric Boiler	65 000	1 500 000	56 000	1.2	-Budget restrictions -Conflicted with a previous program
Wall Insulation Upgrading	72 000	100 000	29 000	25	Simple payback is too high
Incinerator Heat Recovery	37 000	98 000	2 700	14.	Simple payback is too high
Incinerator Fuel Conversion	12 000	0	2 500	4.8	Budget restrictions
Kitchen Exhaust Air Heat Recovery	40 000	290 000	8 200	4.9	Budget restrictions
Propane Dryer Heat Recovery	8 000	33 000	1 400	5.7	Simple payback is too high

2.4 Large Hospitals

The Large Hospital category consists of hospitals with over four hundred beds. The Brandon General Hospital in Brandon and the Salvation Army Grace General Hospital in Winnipeg were selected in this category.

2.4.1 Brandon General Hospital, Brandon

2.4.1.1 Retrofit Description

The energy conservation retrofit at the Brandon General Hospital will reduce the facility's annual energy consumption by 14% and annual energy cost by 11%. The retrofit has an overall payback of 4.0 years. The retrofit components are summarised in Table 2.13 and the overall savings are illustrated in Figure 2.7. Brief ECT descriptions are given below.

Centrifugal Chiller

The facility's cooling plant has two centrifugal chillers (267 and 174 tons' capacity) and two absorption chillers (262 and 240 tons' capacity). Absorption chillers require as much as a ten times greater energy input for a given amount of cooling than do centrifugal chillers. The two absorption units were replaced by one large 600 ton centrifugal chiller. One of the absorption units is being used as a backup; the other is stored for future use elsewhere in the facility.

ETectrostatic Filter

The bag-type air handling filters in the Assiniboine Centre at the Brandon General Hospital were replaced with a self-cleaning electrostatic high efficiency filter. System capacity is 30 888 L/s (65 440 cfm) with continuous operation. The installation presented few complications.

Treatment Building Exhaust Air Heat Recovery

A glycol run-around heat recovery system was installed in the Treatment Building of the facility. Three exhaust coils handling 3 363 L/s (7 125 cfm), 1 933 L/s (4 095 cfm), and 977 L/s (2 070 cfm) recover the heat in the exhaust air. This recovered energy is used to preheat the 7 295 L/s (15 455 cfm) of outside air supplied to two air handling units.

Steam Trap Overhaul

The heating system steam traps throughout the complex varied in age from 10 to 25 years. Most of the traps in the Treatment Centre showed signs of deterioration and sub-standard performance. These units underwent a comprehensive repair program with the objective of increasing the efficiency of the hospital heating systems.

2.4.1.2 Unimplemented ECTs

Several conservation measures were investigated but not carried out under Enerhosp. These are summarised in Table 2.14. A brief description of each is given below.

Boiler Oxygen Control

Combustion efficiency is a function of load and boiler adjustment. It was proposed that an automated oxygen contro system be installed on each of the hospital's three 500 hp. Cleaver Brooks boilers. Automatic oxygen control systems continue to maintain optimum boiler efficiency throughout periods of varying load and ambient conditions - an impossibility with manual adjustment.

Roof Insulation Upgrading

The Westman Medical Centre adjoining the main Treatment Building has a flat deck roof (area 1 600 m^2) with a low insulation value of RSI 1.6 (R9). The possibility of upgrading this level to RSI 7.0 (R40) was investigated.

Electric Boiler

It was estimated that a difference of over 600 kVA exists between night and day electrical demand at the facility. Consideration was given to the installation of a 700 kW electric boiler to operate during off-peak hours, therby avoiding the electrical demand charges that normally make electric heating prohibitively expensive.

Kitchen Exhaust Air Heat Recovery

A glycol run-around heat recovery system was proposed for the facility's kitchen ventilation system. This air handling system runs 13.5 hours per day delivering 100% outside air. The heat recovered from the 4 700 L/s (10 000 cfm) of range exhaust was to be used to preheat the incoming make-up air. This proposed heat recovery system required a washdown system on the exhaust air coil.

Power Factor Correction

Study was given to the practicality of improving the power factor of the two centrifugal chiller compressor motors from 90% to 95%. The power factor at the facility's main electrical service is above 90% because most motors above 11 kW have already been individually power factor corrected with capacitors.

Ventilation Intake Modification

The fresh air intake for the operating theatre air handling unit draws air from above a roof deck where the air is hotter than the ambient air temperature. It was proposed to modify the intake to draw air from the recessed, well-shaded roof directly above the air handling unit. Drawing the air from this location would reduce the total effective cooling load.

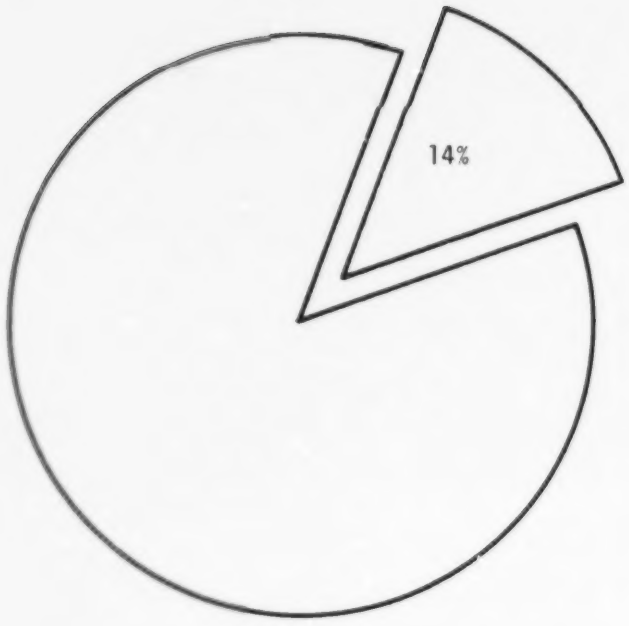
2.4.1.3 Conclusions

Though the initial outcome of project tendering was disappointing, subsequent negotiations between the successful bidder, the facility, and the consultant were highly productive. The resulting retrofit installation represents one of the better Enerhosp project paybacks.

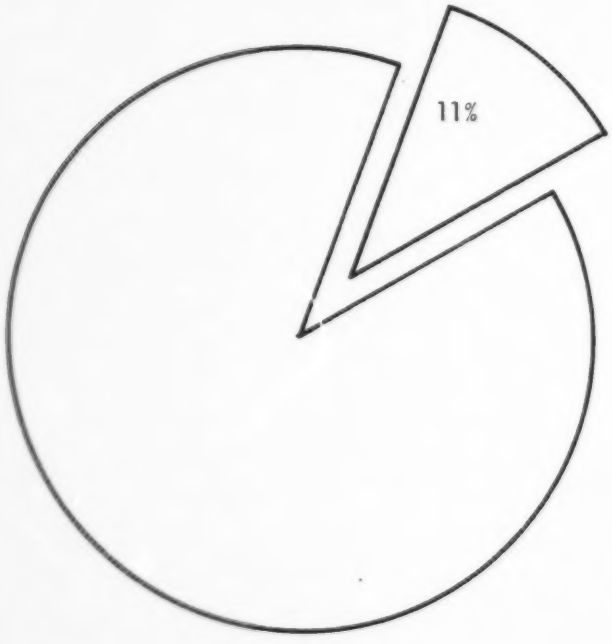
TABLE 2.13

RETROFIT DESCRIPTION - BRANDON GENERAL HOSPITAL, BRANDON

ENERGY CONSERVATION TECHNIQUE	ACTUAL IMPLEMENTATION COST ($)	EXPECTED ENERGY SAVING (kWh/yr)	EXPECTED COST SAVING ($/yr)	SIMPLE PAYBACK (YEARS)
Centrifugal Chiller	194 000	3 400 000	38 000	5.1
Electrostatic Filter	30 000	110 000	5 900	5.1
Treatment Building Exhaust Air Heat Recovery	47 200	710 000	9 700	4.9
Steamtrap Overhaul	12 000	1 300 000	17 000	0.7
OVERALL RETROFIT	283 000	5 500 000	71 000	4.0



Annual Energy
Consumption Saving



Annual Energy
Cost Saving

FIGURE 2.7

ENERGY AND COST SAVINGS - BRANDON GENERAL HOSPITAL, BRANDON

TABLE 2.14

UNIMPLEMENTED ECTS - BRANDON GENERAL HOSPITAL, BRANDON

ENERGY CONSERVATION TECHNIQUE	ESTIMATED IMPLEMENTATION COST ($)	ESTIMATED ENERGY SAVING (kWh/yr)	ESTIMATED COST SAVING ($/yr)	SIMPLE PAYBACK (YEARS)	REASON FOR NOT BEING IMPLEMENTED UNDER ENERHOSP
Boiler Oxygen Control	53 000	540 000	7 400	7.2	Simple payback is too high
Roof Insulation Upgrading	50 000	150 000	2 100	24.	Simple payback is too high
Electric Boiler	50 000	500 000	7 600	6.6	Simple payback is too high
Kitchen Exhaust Air Heat Recovery	44 000	360 000	4 900	9.0	Simple payback is too high
Power Factor Correction	12 000	0	600	20.	Simple payback is too high
Ventilation Intake Modification	1 300	12 000	170	7.6	Simple payback is too high

2.4.2 Salvation Army Grace General Hospital, Winnipeg

2.4.2.1 Retrofit Description

The energy conservation retrofit at the Salvation Army Grace General Hospital will reduce the facility's annual energy consumption by 17% and annual energy cost by 12%. The retrofit has an overall payback of 4.4 years. The retrofit components are summarised in Table 2.15 and the overall savings are illustrated in Figure 2.8. Brief ECT descriptions are given below.

Electric Boiler

A 780 kW electric boiler was installed for off-peak operation. It is controlled by a building automation system which monitors facility electrical demand and modulates the boiler's twelve stages accordingly. Feasibility was accurately determined by using available daily demand profiles to calculate available off-peak hours. Installation costs included about $40 000 in required general electrical service upgrading.

Centrifugal Chiller

Prior to the Enerhosp program, the facility was cooled with a 500 ton steam driven absorption chiller. Power input was about 9 kW of primary natural gas per ton of cooling. This machine was replaced with a new 650 ton centrifugal chiller, with an electrical power requirement of .72 kW per ton. This allowed one boiler to be shut off completely during the summer. The 150 ton capacity increase was implemented in anticipation of future expansion. Installation costs included about $40 000 in required general electrical upgrading. The existing cooling tower system was reused.

2.4.2.2 Unimplemented ECTs

Several conservation measures were investigated but not carried out under Enerhosp. These are summarised in Table 2.16 along with the reasons for their not being implemented. A brief description of each is given below.

Boiler Combustion Control

Combustion efficiency is a function of load and boiler adjustment. It was proposed that an automated oxygen control system be installed on each of the hospital's two 600 hp. Cleaver Brooks boilers. Automatic oxygen control systems continue to maintain optimum boiler efficiency throughout periods of varying loads and ambient conditions - an impossibility with manual adjustment.

Variable Volume Retrofit

Consideration was given to converting the two main constant volume dual duct air handling systems to variable volume systems. This primarily consisted of converting the constant volume boxes to variable volume boxes and providing some means for varying the supply air.

Kitchen Exhaust Air Heat Recovery

A glycol run-around heat recovery system was proposed for the facility's kitchen ventilation system. This air handling system runs 14 hours per day delivering 100% outside air. The heat recovered from the 7 410 L/s (15 700 cfm) of exhaust air was to be used to preheat the incoming 6 370 L/s (13 500 cfm) of incoming make-up air. This proposed heat recovery system required a washdown system on the exhaust air coil.

Power Factor Correction

Study was given to correcting the power factor to 98% from its present 92%. The hospital has already corrected motors above 10 kW for power factor with capacitors.

Elevator Room Heat Reclaim

The elevator room is typically very hot. Heat is given off by the motors in the elevator room. This energy is exhausted directly outside. The air from the elevator room can be redirected to pass through the facility's heat wheels.

Auditorium Fresh Air and Fan Control

The hospital auditorium is ventilated 13 hours per day regardless of occupancy. Interlocking the fresh air damper with the light switch was considered. Shutting the fan off during unoccupied periods was also considered.

Building Vapour Barrier

The facility's vapour barrier is in very poor condition In many places, the vapour barrier does not even exist. However, before any attempt is made to improve it, a detailed examination and heat scan could be performed to determine the extent of the heat loss. Improving the vapour barrier would reduce heat loss, prevent contamination effects of infiltration, and preserve the building structure.

In-House Techniques

Several small ECTs are being considered for implementation by the facility maintenance staff outside of the Enerhosp contract. These include delamping outside canopy light fixtures, delamping interior zone light fixtures, converting to fluorescent lighting in the Boiler House, replacing discoloured fluorescent light lens covers, seasonally resetting thermostats in unoccupied areas, insulating floor level windows adjacent to perimeter heating, and setting back space temperatures at night.

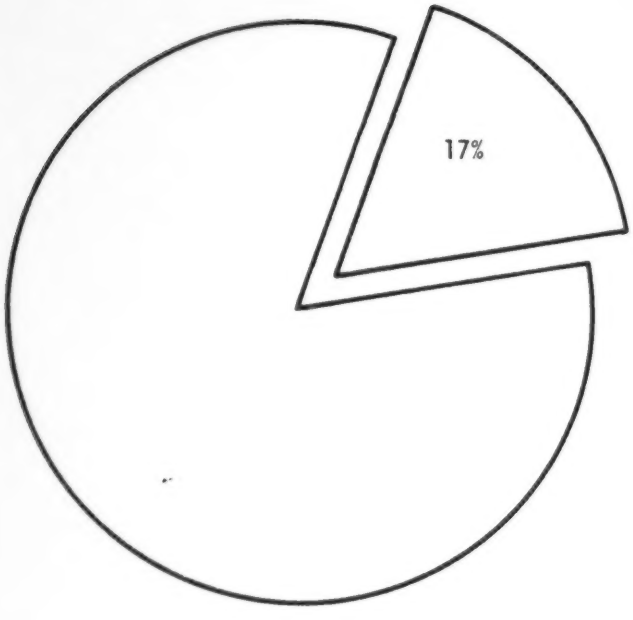
3.4.2.3. Conclusions

The retrofit for this facility consisted of two large installations - a chiller and a boiler. Both these required electrical upgrading. Some extra electrical service ($28 000) was provided from the hospital budget above the amount budgeted under Enerhosp. The hospital now has an expanded electrical service for future use.

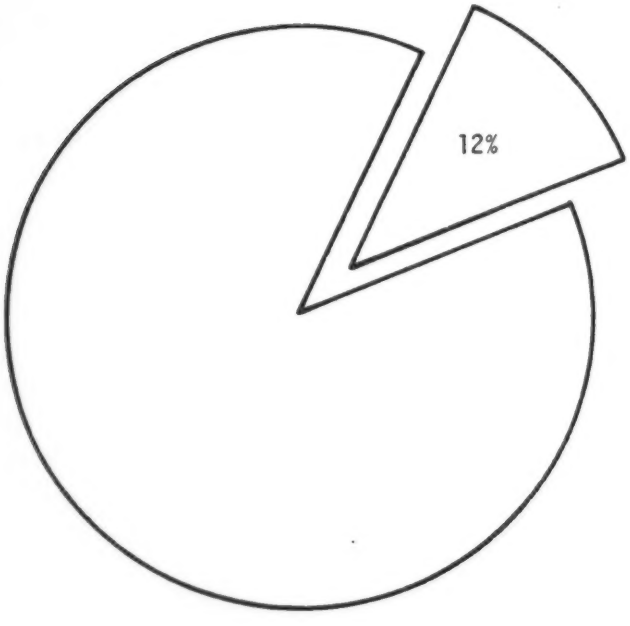
TABLE 2.15

RETROFIT DESCRIPTION - SALVATION ARMY GRACE GENERAL HOSPITAL, WINNIPEG

ENERGY CONSERVATION TECHNIQUE	ACTUAL IMPLEMENTATION COST ($)	EXPECTED ENERGY SAVING (kWh/yr)	EXPECTED COST SAVING ($/yr)	SIMPLE PAYBACK (YEARS)
Electric Boiler	75 000	920 000	14 000	5.4
Centrifugal Chiller	190 000	4 100 000	46 000	4.1
OVERALL RETROFIT	265 000	7 000 000	60 000	4.4



Annual Energy
Consumption Saving



Annual Energy
Cost Saving

FIGURE 2.8

ENERGY AND COST SAVINGS - SALVATION ARMY GRACE GENERAL HOSPITAL, WINNIPEG

TABLE 2.16

UNIMPLEMENTED ECTS - SALVATION ARMY GRACE GENERAL HOSPITAL, WINNIPEG

ENERGY CONSERVATION TECHNIQUE	ESTIMATED IMPLEMENTATION COST ($)	ESTIMATED ENERGY SAVING (kWh/yr)	ESTIMATED COST SAVING ($/yr)	SIMPLE PAYBACK (YEARS)	REASON FOR NOT BEING IMPLEMENTED UNDER ENERHOSP
Boiler Oxygen Control	60 000	410 000	5 800	10.	Simple payback is too high
Variable Volume Retro-fit	150 000	830 000	19 000	7.9	Simple payback is too high
Kitchen Exhaust Air Heat Recovery	39 000	440 000	6 200	6.3	Simple payback is too high
Power Factor Correction	15 000	0	4 800	3.1	Budget restrictions
Elevator Room Heat Recovery	6 000	95 000	1 300	4.6	Budget restrictions
Auditorium Fresh Air and Fan Control	2 500	42 000	590	4.2	Budget restrictions
Building Vapour Barrier	-	-	-	-	More testing is required
In-House Techniques	N/A	unavailable	unavailable	< 5.0	-Budget restrictions -Being considered out of contract

The Enerhosp programme was highly successful. Individual facility payback periods were generally within five years with a 3.9 year overall payback period. The program can be summarised as follows:

- total implementation cost	$915 000
- total expected energy saving	16 500 000 kW.h/yr
- total expected cost saving	$237 000/yr
- overall simple payback	3.9 years

Numerous energy conservation measures were evaluated by the consultants. For an extensive evaluation of all potential areas of energy conservation in health care facilities, the reader is directed to read ENERGY CONSERVATION FOR MANITOBA HEALTH CARE FACILITIES available at Manitoba Energy & Mines and E.J. Faraci & Associates Ltd. This publication is intended to serve as an information source for the health care facility administrator, maintenance manager, or power engineer who is looking for ways to reduce energy consumption and costs.

The success of this programme suggests that other health care facilities should explore their potential for energy conservation. Considerable interest in this area was shown during the two Enerhosp seminars presented in early 1985. The Facility Index Survey Report which will be available late in 1985 will be helpful to a facility's administrators in determining their facility's potential for energy conservation. Energy conservation measures implemented today can make money from future budgets available for further conservation efforts or an increased level of service.